

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:
KIM ET.AL.
SERIAL NO. : 10/624,254

FILED: JULY 22, 2003

FOR: Functional Coatings for the
Reduction of Oxygen
Permeation and Stress and
Method for Forming the Same

Examiner: A. Austin

Group Art Unit: 1775

Statement of the Substance of the Interview by Applicants

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

An interview on Nov. 9, 2006 with the Examiner was directed to the following independent claims 1, 13, 25, 31, 37, and 43 as last amended in an Amendment After Final filed on Oct. 4, 2006.

The Applicants contended:

1. Section 112 rejection of claim 1 can be removed by amending the claim to include the limitation that cryomilling occurs before thermally spraying.

1. A method for improving a thermal barrier coating comprising:

providing a substrate;

cryomilling MCrAlY without the inclusion of other metallic alloys to provide

providing a bond coat composed substantially only of nanocrystalline MCrAlY, where M is comprised of at least one of the group of stands for either Co, Ni and/or Fe;

~~using a thermal spray process~~ thermally spraying the nanocrystalline MCrAlY
onto a metallic substrate; and
providing a ceramic top coat on the nanocrystalline bond coat.

The Applicants understood that Examiner would be amendable to withdrawing the sec. 112 rejection if such an amendment were made. No agreement was entered.

2. Section 112 rejection of claims 37 and 43 can be removed by claiming a nanocrystalline MCrAlY bond coat on the substrate without inclusion of other metallic alloys instead of a “fully nanocrystalline MCrAlY” layer.

This is an accurate restatement of the disclosure of the specification. The specification includes multiple references to the fact that the disposed layer is a nanocrystalline MCrAlY layer without any other metallic alloys in it, or that the metallic alloy system used in the layer is only composed of MCrAlY.

37. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a substrate;
a fully-nanocrystalline MCrAlY bond coat on the substrate without inclusion of other metallic alloys; and
a ceramic top coat on the fully nanocrystalline bond coat.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

- a substrate;
- a fully-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;
- a ceramic top coat on the fully-nanocrystalline bond coat; and
- an Al₂O₃ nanoparticle additive disposed throughout the fully-nanocrystalline MCrAlY bond coat which Al₂O₃ nanoparticle additive was added during cryomilling of the a MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner would be amendable to withdrawing the sec. 112 rejection if such an amendment were made. No agreement was entered.

3. **Section 102 rejection of claims 1, 13, 25, 27, 31, 33 and 37 over Hebsur '725 can be removed by noting:**

- **That Hebsur '725 only discloses a NIAL and CoCrAlY system; and**
- **Each of the claims is limited to bond coat composed substantially of nanocrystalline MCrAlY without inclusion of other metallic alloys.**

1. A method for improving a thermal barrier coating comprising:
providing a substrate;

cryomilling MCrAlY without the inclusion of other metallic alloys to provide
providing a bond coat composed substantially only of nanocrystalline MCrAlY, where M
is comprised of at least one of the group of stands for either Co, Ni and/or Fe, ;
using a thermal spray process thermally spraying the nanocrystalline MCrAlY
onto a metallic substrate; and
providing a ceramic top coat on the nanocrystalline bond coat.

13. (currently amended) A thermal barrier coating comprising:
a substrate;
a bond coat substantially only composed of nanocrystalline MCrAlY without
inclusion of other metallic alloys, where M is comprised of at least one of the group of
stands for either Co, Ni and/or Fe, using a high velocity oxy fuel (HVOF) thermal spray
process or low pressure plasma (LPPS) spray process onto a metallic substrate on the
substrate; and
a ceramic top coat on the nanostuctured, nano-composite bond coat.

25. (currently amended) A method for improving a MCrAlY thermal barrier coating
made from MCrAlY powder, where M is a metal or metal alloy, comprising:
providing a MCrAlY bond coat on a substrate; and
providing a nanocrystalline nano-composite coating on the MCrAlY bond coat
without inclusion of other metallic alloys with a where the nanostructured nano-
composite bond coating is prepared only by refining the microstructure of the a MCrAlY

powder used to make the nanostructure nano-composite coating to nanocrystalline grain size.

31. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

 a MCrAlY bond coat on a substrate; and
 a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains without inclusion of other metallic alloys on the MCrAlY bond coat on the a substrate.

37. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

 a substrate;
 a fully-nanocrystalline MCrAlY bond coat on the substrate without inclusion of other metallic alloys; and
 a ceramic top coat on the fully nanocrystalline bond coat.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

 a substrate;
 a fully-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;
 a ceramic top coat on the fully-nanocrystalline bond coat; and

an Al₂O₃ nanoparticle additive disposed throughout the fully-nanocrystalline MCrAlY bond coat which Al₂O₃ nanoparticle additive was added during cryomilling of the-a MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner would be amendable to withdrawing the sec. 102 rejection if such an amendment were made. No agreement was entered.

4. Section 103 rejection of claim 43 over Hebsur '725 and '654 can be removed by noting that Hebsur '725 and '654 only teach in situ formation of alumina in a NiAl system and that Hebsur '725 does not teach formation of alumina during cryomilling¹.

Claim 43 is directed to a step of providing an alumina coating by cryomilling an alumina powder to achieve nanocrystalline grain sizes and disposing the cryomilled nanostructured alumina composite coating on a bond coat on the substrate.

43. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a substrate;

a fully-nanocrystalline MCrAlY bond coat without inclusion of other metallic alloys on the substrate;

a ceramic top coat on the fully-nanocrystalline bond coat; and

¹ See page 9 of the Office Action in reference to claims 34, 35.

an Al₂O₃ nanoparticle additive disposed throughout the fully-nanocrystalline MCrAlY bond coat which Al₂O₃ nanoparticle additive was added during cryomilling of the-a MCrAlY powder from which the nanocrystalline MCrAlY bond coat was formed.

The Applicants understood that Examiner did not contest the argument or offer a basis of refutation from any of the cited references. The teaching of Hebsur '725 relating to Fig. 5 was distinguished by Applicants. No agreement was entered.

5. Section 103 rejection of claim 31 over Hebsur '725 in view of Cybulsky can be removed by noting:

- **That Cybulsky discloses a MCrAlY protective coating 18 disposed between a substrate 12 and a bond coat 20 of Ir-Nb alloy; and**
- **That Hebsur teaches a NiAl-MCrAlY bond coat system,**
- **Therefore the combination of Cybulsky with Hebsur might suggest placing a second layer of MCrAlY between the NiAl- MCrAlY bond coat and the substrate, but there is no teaching, motivation or inference that the second layer of MCrAlY must be a nanostructured nano-composite layer.**

Cybulsky is totally silent with respect to the crystalline structure or sizing of the second layer of MCrAlY and never mentions cryomilling in any context. Cybulsky's second layer is for protection of the substrate against oxidation and hot corrosion and has no connection with bonding. There is no inference that this characteristic would be important for an intermediate bond coat or that the MCrAlY would need a

nanostructured nano-composite second bond coat underneath it. Nothing in Hebsur '725 is related to MCrAlY-nanocoating MCrAlY-bond coats.

31. (currently amended) A MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy, comprising:

a MCrAlY bond coat on a substrate; and
a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains without inclusion of other metallic alloys on the MCrAlY bond coat on the a substrate.

The Applicants understood that Examiner did not contest the argument or offer a basis of refutation in any of the cited references. Further search was cited as possibly needed. No agreement was entered.

Applicant respectfully requested advancement of the claims to allowance.

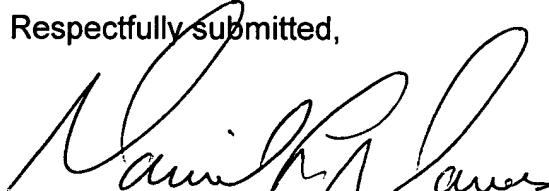
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on November 27, 2006 by JoAnn Brees.

Signature

November 27, 2006

11/27/06

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Please charge Deposit Account No. 01-1960 for any additional fees pertaining to this case.